

IN THE ABSTRACT

Please replace the present abstract with the following:

ABSTRACT OF THE DISCLOSURE

Methods and apparatus are described for cantilever structures that include a vertically aligned nanostructure, especially vertically aligned carbon nanofiber scanning probe microscope tips. An apparatus includes a cantilever structure including a substrate including a cantilever body, that optionally includes a doped layer, and a vertically aligned nanostructure coupled to the cantilever body. A method includes A method, includes fabricating a cantilever structure having a vertically aligned nanostructure including: forming a doped layer at a first side of a substrate; depositing an etch mask layer on a second side of the substrate; forming a plurality of alignment marks that are coupled to the first side of the substrate; depositing a catalyst nanoparticle at a deterministic site that is coupled to the doped layer; growing the vertically aligned nanostructure at the deterministic site with the catalyst nanoparticle; depositing a first protective layer that surrounds at least a portion of the vertically aligned nanostructure; patterning the first protective layer to define an outline of a cantilever body; transferring the outline of the cantilever body from the first protective layer into the doped layer to form the cantilever body from the doped layer; depositing a second protective layer that coats at least a portion of a surface of the cantilever body; patterning the etch mask layer to define an outline of a relieved volume; transferring the outline of the relieved volume from the etch mask layer into the second side of the substrate to remove the relieved volume from the substrate, where the cantilever body is not removed.